FLIGHT APPLICATION INSTRUCTIONS – FY 2006

OF-300-11-H

MAY 2005

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NATIONAL SCIENTIFIC BALLOON FACILITY
Palestine, Texas

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GLOSSARY

ASCII	American Standard Code for Information Interchange; a code for representing alphanumeric information
ASME	American Society of Mechanical Engineering
BGSP	NSBF Balloon Ground Safety Plan
BSPSP	balloon system pre-launch safety package
Category A hazard	Meets all the following requirements: 1) initiation of the system could lead to a chain of events which result in injury, death, or property damage 2) sufficient energy exists to start the chain of events 3) the energy output of the system is not controlled or contained
Category B hazard	Those systems which: 1) are highly improbable of being initiated 2) do not cause injury or property damage by their own direct initiation or the sequence of events they initiate
CIP	consolidated instrument package
CRM	campaign requirement meeting
Dewar	vacuum flask that holds liquid air or helium for scientific experiments
DOT	Department of Transportation
EED	electro-explosive device
GPS	global positioning system
GSE	ground station equipment
GSFC	Goddard Space Flight Center
L Band	US standard industry RF band from 1000 to 2000 MHz
MOU	memorandum of understanding
MSDS	material safety data sheet
NASA	National Aeronautics and Space Administration
NOHD	nominal ocular hazard distance
NM	nautical mile
NSBF	National Scientific Balloon Facility
NLSA	nuclear launch safety approval
NOHD	nominal ocular hazard distance
PPE	personal protective equipment
RAC	risk assessment code
RF	radio frequency
RSO	radiological safety officer
RSQA	reliability, safety, and quality assurance
S Band	US standard industry RF band from 2000 to 4000 MHz
SPOD	Suborbital Projects and Operations Directorate
TDRSS	tracking and data relay satellite system
UHF	ultra high frequency, US standard industry RF band from 300 to 1000 MHz
VHF	very high frequency, US standard industry RF band from 30 to 300 MHz

CONTACT INFORMATION

SERVICE	CONTACT
Cost estimates, fund transfers	Bernice Merritt (BPO)
First-time conventional and LDB flight notification	Bill Stepp (NSBF), Bernice Merritt* (BPO)
Flight support applications – conventional	Mona Breeding (NSBF)
Flight support applications – long-duration balloon (LDB)	Mona Breeding, Bryan Stilwell (NSBF)
Flight support documentation	Mona Breeding (NSBF)
Gases, cryogens	NSBF Cryogen Purchasing
Gondola design certification	Hugo Franco (NSBF)
New gondola design notification	Hugo Franco (NSBF), Bernice Merritt* (BPO)
Non-NASA sponsored funding	Bernice Merritt (BPO)
Post-flight assessments and forms	Bernice Merritt (BPO)
Pressure vessel certification	Hugo Franco (NSBF)
Radioactive material documentation requirements	Erich Klein (NSBF)
Radioactive materials	Erich Klein (NSBF)
Requirements or schedules	Bill Stepp (NSBF)
User-purchased balloons	Jim Rotter (NSBF)
User services, questions	Bill Stepp (NSBF)
Waiver of Claims form	Mona Breeding (NSBF)

** Contact in addition to NSBF*

ADDRESS	NAME	PHONE	FAX	E-MAIL
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	Cryogen Purchasing		866-441-7849, 903-723-8054	cryogens@nsbf.nasa.gov
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1 GENERAL POLICIES AND PROCEDURES

1.1 BALLOON FLIGHT SUPPORT APPLICATION

All scientific groups requesting NASA/NSBF support must submit a Balloon Flight Application of each year. The application is issued from and must be returned to the NSBF. Initial point of contact with the NSBF is Mona Breeding (see NSBF Contact Information on page v). Normally, a conventional flight application is valid only for the next fiscal year.

Science groups requesting long-duration balloon (LDB) support, involving transcontinental flights or launches from the Arctic or Antarctic, must submit an LDB Flight Support Application at least two years in advance of the requested support. The advance application for LDB flights is due to the long lead time required for logistics in addition to operational planning with associated support organizations. Normally LDB flight applications are valid for two years. Bernice A. Merritt is the NASA LDB Program Manager and should be contacted directly regarding LDB flight support applications (see NSBF Contact Information on page v). Specific details regarding LDB flight requirements not addressed in the LDB Flight Support Application will be covered through direct contact with the science group.

Science groups that are submitting a Balloon Flight Support Application for the first time, or groups that are submitting an application for a new gondola that has not been launched by NSBF before, must also contact the NASA Balloon Projects Branch. The point of contact is Bernice A. Merritt. This contact is to inform NASA of the new project and enable planning to begin prior to the time that NSBF submits the proposed flight program to NASA. Contact should be made about the same time that the Balloon Flight Support Application is submitted to NSBF.

1.1.1 PRE-FLIGHT MINIMUM SUCCESS CRITERIA FORM

All scientific groups requesting NASA/NSBF flight support must submit a Pre-Flight Minimum Success Criteria form along with the Balloon Support Application. This form is available from the NSBF Web site at http://www.nsbf.nasa.gov/docs.html. It provides insight into the expected science performance requirements and is used to assess the scientist's needs. The launch support group uses the requirements for flight planning. Because a launch will not be attempted without assurance that the minimum scientific requirements can be met, the experimenters should be realistic in specifying criteria.

Should there be any changes in requirements or schedule, please notify the NSBF as costs and program plans could be affected.

1.1.2 NOTIFICATION

NSBF will notify the scientific group within three weeks of receiving the application and inform them of any problems associated with flight requirements. Subsequent notifications will be made after NASA flight program approval.

1.1.3 NON-NASA SPONSORED PROGRAMS

All funding for non-NASA sponsored users must be provided through fund transfers from the sponsoring agency to NASA. Upon receipt of funds, NASA approves the NSBF to establish an account for the user. (A user's fee is not assessed to national users.)

Foreign users are required to have a Memorandum of Understanding (MOU) with NASA Headquarters. Additionally, foreign users will be assessed a users fee for each flight. All funding, including the users fee must be provided to NASA as per the established MOU.

No direct procurement can be made by the NSBF for services until the necessary agreements are in place and monies have been received from the user.

Information regarding cost estimates, contractual agreements, MOU's with NASA and instructions pertinent to the transfer of funds may be obtained by contacting Bernice Merritt (see NSBF Contact Information on page v).

1.1.4 PROJECT INITIATION CONFERENCE

Every major remote campaign on large projects requiring operational support includes a project initiation conference (PIC). The PIC is hosted/chaired by NASA, and participation by the NSBF and the science group is required. The PIC objectives are to review NSBF support plans and science requirements once the project or campaign has been approved.

1.1.5 USER-PURCHASED BALLOONS

The NSBF normally provides the balloons, but will launch balloons purchased directly by the users, as long as they comply with NSBF design and QC/QA requirements. The balloon design must be reviewed by the NSBF to assure compliance with NASA/NSBF balloon specifications prior to production. The normal NSBF QA and manufacturer QC procedures must be in force during production.

1.1.6 BATTERIES

The NSBF provides batteries to NASA programs and upon request, will act as a battery purchasing agent for non-NASA funded experimenters. Batteries cannot be purchased until funds are received by NASA and authorization is received by NSBF. However, only lithium cells and/or packs of the type routinely used by the NSBF will be available. The user should detail battery requirements in the balloon flight support application and ensure that the necessary funds are made available.

1.1.7 GASES / CRYOGENS

All NSBF balloon flight candidates submit a Balloon Flight Support Application that details the operational support requirements for their flight, including gases and cryogens. Because the application is submitted in advance of the actual flight, it is used primarily by Operations for planning and scheduling, not purchasing supplies or equipment.

Each science group scheduled to launch from Palestine, Texas or Ft. Sumner, New Mexico orders gases/cryogens by submitting a gas/cryogen order form to NSBF Cryogen Purchasing. To obtain an order form:

TYPE OF REQUEST	INSTRUCTIONS
Web Download	Log on to http://www.nsbf.nasa.gov/docs.html and download the Gas/Cryogen Order Form to your PC.
E-mail	Send an e-mail requesting an order form to cryogens@nsbf.nasa.gov, Subject: Gas/Cryogen Order Form Request.
Fax	Fax your request for an order form to 866-441-7849, Attn: Cryogens. Alternate fax number: 903-723-8054, Attn: Cryogens. Please call 903-729-0271 to verify the fax was received.

To assure timely delivery of cryogens and specialty gases, orders must be placed no less than fourteen (14) days prior to the flight

FOR REMOTE CAMPAIGNS: No less than twenty-one (21) days

LDB flight cryogen and gas requirements are handled differently than that for conventional flights. The NSBF Campaign Manager will coordinate with the LDB science user concerning gas and cryogen support. For Antarctica, certain logistics demands may require shipment of specialty gases as much as a year in advance. Therefore, it is important to identify these needs early enough to accommodate your needs. Any gases or cryogens required during the pre-deployment integration at Palestine will be handled in accordance with the other instructions contained in this section.

Liquid nitrogen, liquid helium, dry oxygen, argon, nitrogen and helium can be readily obtained. Any other type of gas is considered a specialty gas. **Please allow thirty (30) days for delivery of specialty gases for domestic flights and forty-five (45) days for remote campaigns.**

Hospital grade and industrial grade dry nitrogen are readily available.

Orders will be placed only for those flights which have been approved. Each flight that has been approved has an established funding level based upon the information you provided in the flight request. Should your gas requirement exceed this level, NASA will have to provide approval for any dollar amounts exceeding the established funding level.

1.1.8 GONDOLA DESIGN CERTIFICATION

All range users must provide NSBF with gondola and suspension structural design information, material specifications, load test information, etc., **60 days** prior to arrival at the launch site. Final gondola design certification shall be performed by the NSBF using the NASA/NSBF accepted criteria. NASA-sponsored experimenters requesting balloon flights at launch sites other than Palestine, Texas and not requiring NSBF services shall forward this information to the Balloon Projects Branch at Wallops Flight Facility. Any further distribution will be made from that office. Details of these criteria are included in Chapter 2, Structural Requirements for Balloon Gondolas, on page 5.

1.1.9 PRESSURE VESSEL CERTIFICATION

All scientists flying pressure vessels of any type on their payload must submit a brief treatise on the vessels for review and approval by NASA/WFF engineers (see section 5.3.4, Pressure Systems on page 18). The description need not be overly elaborate. A few paragraphs will suffice. The statement should contain general information on:

- Design specifications of the vessel(s)
- Description of any ground testing performed on the vessel(s)
- Any flight history of the vessel(s)

1.1.10 RADIOACTIVE SOURCES

All range users must submit the following documentation to the NSBF Radiological Safety Officer at least four weeks prior to the arrival of the science group to a launch site:

- Copy of the Radioactive Material License for their institution.
- Current leak test documentation for all radioactive material. License and laws of the State of Texas require that Alpha-emitting sources be tested every three months.

- Other sealed sources must be tested every six months. Any source arriving without a current test certificate will be impounded until it is leak tested, even if it requires gondola disassembly. The scientific investigator will be responsible for all costs incurred for leak tests at the NSBF.
- A list of the individuals in the science group who are authorized to handle radioactive sources.

In addition, range users who intend to bring radioactive sources to the NSBF or other launch site are required to complete the Radioactive Material Hold Harmless and Indemnification form. This form is to be submitted with the Balloon Flight Support Application. See section 5.3.1, Ionizing Radiation on page 15 for additional information.

1.2 WAIVER OF CLAIMS

All user institutions and users are required to complete the NSBF Waiver of Claims Form. The person signing for the user institutions and users must be someone who can "bind" the organization, e.g., Contracting Officer, Contracting Manager, Principal Investigator, and Division Head.

The NSBF will retain the waivers on file by institution name, through the effective date on the claim form. This form will cover all scientists from their respective institution for that time period.

The waiver form should be sent by the user institution or user, with the other data that is provided when a scientist makes a request for NSBF services.

The scientist must understand that both the scientist and his/her employer have to sign the waiver and return it to the NSBF before flights will be authorized.

If a scientist or institution has questions concerning the waiver form, they should contact Mona Breeding, Administrator, NSBF Site Manager's Office (see NSBF Contact Information on page v).

1.3 POST-FLIGHT SCIENCE ASSESSMENT

A post flight assessment of the preliminary science results is required. A form is available from NSBF, and it will be given to the Principal Investigator at the post flight critique held by the NSBF Operations Department. The completed form should be mailed to Bernice A. Merritt, NASA-WFF, at the address on the form. NASA-WFF will not establish the NASA-reported mission performance until a post flight assessment form is received. Significant delay in receipt of the form could impact future flight support.

2 STRUCTURAL REQUIREMENTS FOR BALLOON GONDOLAS

2.1 INTRODUCTION

The gondola certification program helps to ensure that containment frames and suspension systems supplied by scientists are mechanically capable of withstanding the stresses placed on them by launch, flight, termination, and impact.

The NSBF Engineering Department uses the scientist's design information and stress analysis to assess a gondola's suitability and to certify the structure. The scientist is responsible for the design and analysis of the gondola. The gondola stress analysis must be performed by an engineer whose qualifications must be provided to the NSBF in the form of a brief resume. Primary point of contact is the Manager of NSBF Engineering, contacted through Mona Breeding (see NSBF Contact Information on page v).

Although NSBF engineers are available to answer questions on design problems or unusual projects, the NSBF certifying engineer's primary role is to identify critical structures, determine whether the analysis has examined these structures and spot-check pertinent calculations. Based on the stress analysis provided, the engineer gives the gondola an overall rating and determines how much weight the entire structure can handle. The scientist is then notified of the certification based on his design and stress analysis.

2.2 DESIGN SPECIFICATION GUIDELINES

Using the following guidelines, the scientist must provide design specifications and a stress analysis of the gondola to the NSBF at least 60 days prior to the anticipated flight date.

- Drawings showing the relative locations and dimensions of all structural and load-bearing gondola members; materials identification shall be included in all drawings
- At least one complete assembly drawing
- Working drawings and specifications for all purchased and fabricated mechanical components and assemblies that are part of the flight train (e.g., rotators, swivels, turnbuckles, clevises, rings, and universal joints)
- A stress analysis of all major structural members, including decks and ballast attachment points. Identify the components, equipment, and weights comprising the loads
- Engineering Manager will assign a staff engineer to interface with each payload group
- A statement certifying that the aforementioned requirements have been met. This statement must be signed by the principal investigator and the engineer responsible for the gondola structure

The documentation for a certified gondola design is filed by the NSBF Engineering Department, and gondolas need not be re-analyzed for subsequent flights unless design changes are made. However, NSBF engineers visually re-inspect the assembled gondola before each flight, and the principal investigator is required to sign a Science Gondola Modification Certification Form verifying that the previously certified design was not changed.

2.3 DESIGN CRITERIA

The following design criteria should be used in planning gondola structures and suspension. Gondolas must be designed so that all load-carrying structural members, joints, connectors, decks, and suspension systems are capable of withstanding the conditions listed below without ultimate structural failure.

- A load 10 times the weight of the payload applied vertically at the suspension point.
- For multiple-cable suspension systems, each cable must have an ultimate strength greater than five times the weight of the payload divided by the sine of the angle that the cable makes with horizontal (should be >30 degrees) in a normal flight configuration. Cable terminations, cable attachments, and gondola structural members must be capable of withstanding the load described above. Some exceptions to this criterion may be allowed for gondolas with more than four suspension points at the discretion of the NSBF certifying engineer.
- A load five times the weight of the payload applied at the suspension point and 45 degrees to the vertical. This load factor must be accounted for in the direction perpendicular to the gondola's short side, perpendicular to the gondola's long side, and in the direction of the major rigid support members at the top of the gondola structure. If flexible cable suspension systems are used, they must be able to withstand uneven loading caused by cable buckling.
- A side acceleration of 5 g applied to all components and equipment attached to and/or onboard the gondola structure or any portion of the flight system below the balloon.
- The effects of stress concentration factors must be considered in the analyses of all critical mechanical structures and assemblies. The ultimate strength of the element should be de-rated proportionately to the applicable stress concentration factor. The stress concentration factors shall be based upon the specific load case and standard mechanical engineering design practices. A specific example of a structural element in which stress concentrations are to be considered is the shaft and housing of a swivel or rotator assembly.
- If a particular element does not pass when derated by the full effects of the stress concentration factor, the stress analyst must demonstrate that other factors such as material ductility offset the effects of stress concentrations. For instance, a tensile/pull test of an assembly can be used to demonstrate that it has an ultimate strength greater that the above criteria will allow. The NSBF recommends that proof tests be conducted by the science group as a standard practice to ensure that their hardware has adequate strength.
- The ductility of all materials used for critical mechanical elements shall be considered in the analysis of the gondola structure. Specifically, the NSBF does not encourage the use of materials that are determined to be brittle or that are not recommended for use in shock loading applications. Close examination of all materials that have a percent elongation less than or equal to 10% at an ambient temperature of -60 degrees Celsius shall be made to determine if the material is to be considered brittle.

  If a material is determined to be brittle, the certification criteria listed in paragraphs 1, 3 and 4 must be multiplied by a factor of 1.5. That is, the particular element that is fabricated using a brittle material must be able to sustain a 15-g vertical load, a 7.5-g load at 45 degrees, and a 7.5-g horizontal load without failure.

The gondola design also must ensure that all scientific equipment, NSBF equipment, and ballast remain contained when subjected to the loads described above and that the gondola is capable of supporting the weight of NSBF equipment. The NSBF Engineering Department should be contacted during the design stage for information on equipment and ballast weight for the flight.

2.4 GONDOLA DESIGN REVIEW

The following assumptions are made by the NSBF certifying engineer in reviewing gondola design analyses:

- The suspension point is defined as the point where the scientist-furnished gondola suspension equipment interfaces with the NSBF-furnished flight system hardware.
- The payload weight includes the gondola structure, all scientific equipment and components, and all NSBF equipment (including ballast) affixed to the structure below the gondola suspension point.
- For analysis purposes, the base of the gondola may be assumed to be rigidly fixed (i.e., in a static condition). Other boundary conditions may be used upon prior approval of the NSBF.

2.5 VISUAL INSPECTION

The final stage of gondola certification is a visual inspection by an NSBF engineer. The gondola is checked for adequate suspension and crush pad cushioning. In addition, the certifying engineer checks welds and verifies that the construction matches the description submitted by the user.

3 GSFC FASTENER INTEGRITY REQUIREMENTS

3.1 GENERAL

The Suborbital Projects and Operations Directorate (SPOD) is requesting exclusion for SPOD programs except as noted herein.

The sounding rocket and balloon programs are established efforts that share the relatively low cost, high risk, rapid response philosophy of obtaining a maximum in scientific return at a minimum cost. The programs have relied on comprehensive testing structural analysis, and inspection to serve as the check and balance for flight reliability.

To ensure the integrity of fasteners used in Code 800 flight programs, but in keeping with the nature of these programs, Code 800 will implement a new policy. This requires all future procurements of structural threaded fasteners intended to be used for flight hardware and safety critical (where a single failure could result in injury to personnel or damage to property or flight hardware by dropping or losing control of the load) nuts and bolts and GSE hardware to be procured from one of the following, or to include a requirement to meet a tensile load specification.

- Defense Industrial Supply center
- Vendors that appear on the approved sources list (Appendix I of GSFC Spec. S-313-100)
- Vendors supplying traceable certifications

A minimum sample of three items from each procurement will be tested to demonstrate compliance with the procurement specification, unless procured from sources a, b, or c above. Items exceeding the tensile test capability or which for other reasons are not suitable for tensile test may be hardness tested to determine equivalent strength. Organizations not having testing capabilities may send sample test items to the Experimental Mechanical Construction Section (Code 821.2) for testing.

Threaded fasteners which are single-point failure items on flight hardware or which have single-point failure with personnel safety implications on ground support equipment will be load tested and visually inspected in all cases.

This same policy will be imposed on the contractors for hardware provided in support of these programs. The flight experimenters, however, would be considered exempt from these policies although they would be informed of the concerns and the approved sources and would be offered the use of services of Code 821.2 for sample testing of threaded fasteners. Successful comprehensive testing of integrated systems will still provide the basis for final flight approval, except for the balloon program. The balloon program will continue to rely on structural analysis, inspection, and in the case of single-point failure fasteners, tensile or hardness testing will be performed. Safety critical items, in all cases, will continue to be emphasized.

If you have any questions about the implementation of this policy, contact the NSBF Engineering Manager through Mona Breeding (see NSBF Contact Information on page v).

3.2 LIST OF GSFC-APPROVED MANUFACTURERS

(Appendix I, GSFC S-313-100)

Safe life or single-point fasteners must be made by these manufacturers or by manufacturers that are audited by the developer. Fasteners may be purchased directly from the manufacturer or from any distributor.

Table 1 GSFC-Approved Fastener Manufacturers

MANUFACTURER	ADDRESS	PRODUCTS
Air Industries Corp.	12570 Knotted St. Garden City, CA 92641 (714) 892-5571	Aerospace bolts
Federal Manufacturing Co.	9825 Dazed Ave. Chatsworth, CA 91311 (818) 341-9825	Limited NAS bolts
Bristol Industries	630 E. Lambert Rd. Area, CA 92622 (714) 990-4121	12-point bolts, hex and double-hex, self-locking nuts, channel nuts
GC Aerospace	1307 Winemaker Ave. Ontario, CA 91761 (714) 988-0053	Aerospace bolts, non-locking nuts
California Screw Products	14957 Gwenchris Ave. Paramount, CA 90723 (213) 633-6626	AN, MS, NAS bolts
Hi-Shear Corp.	2600-T Skypark Dr. Torrance, CA 90509 (213) 326-8110	Aerospace bolts, blind fasteners, inserts, fastening systems
Cherry Aerospace	1224 Warner Ave. Santa Ana, CA 92707 (714) 545-5511	Blind Fasteners, self-locking nuts
Kaynar Mfg. Division	800 S. State College Blvd. Fullerton, CA 92634 (714) 871-1550	Locknuts, special nuts, inserts
Crescent Mfg. Co.	700 Geo. Washington Tpk. Burlington, CT 06013 (203) 673-2591	Bolts and screws, rivets
Beutsch Fastener Corp.	3969 Paramount Blvd. Lakewood, CA 90712 (213) 421-3711	Aerospace bolts, nut plates rivets, captive screws
Monogram Aerospace Fasteners	3423 S. Garfield Ave. P.O. Box 6847 Los Angeles, CA 90040 (213) 722-6740	Blind fasteners

4 INSTRUCTIONS FOR USER COMMAND INTERFACE

4.1 USER INTERFACE PORT CONFIGURATION

Default:

1200 baud
No parity
8 bits
1 stop bit

Available baud rates include 1200, 2400, 4800, 9600.

(Baud rate does NOT affect the rate of outgoing commands.)

4.2 USER COMMAND REQUEST PACKET

Use this packet format to request that user commands be sent to the consolidated instrument package (CIP)/payload. This packet is sent from the user computer to the NSBF ground station equipment (GSE) computer.

(Users are not allowed to command NSBF balloon control systems.)

`Syyyy(SP)xxqSyyyy(SP)xxqSyyyy(SP)xxq(CR)(LF)`

Where:

`S`	=		ASCII 53h
`yyyy`	=	four-character command	hex for data word and discrete
`(SP)`	=	space	ASCII 20h
`xx`	=	address in hex	
`q`	=	either W for data word or K for discrete	ASCII 57h ASCII 4Bh
`(CR)`	=	carriage return	ASCII 13h
`LF`	=	line feed	ASCII 10h

4.2.1 USER COMMAND EXAMPLES

4.2.1.1 Discrete Command Example for Address 12h, Command 13h

`S0013 12KS0013 12KS0013 12(CR)(LF)`

4.2.1.2 Data Word Command Example for Address 12h, Command AB03h

`SAB03 12WSAB03 12WSAB03 12W(CR)(LF)`

4.3 USER COMMAND VERIFICATION PACKET

The NSBF command management system will return this packet to the user to verify that a user command request packet has been received AND that the command has been sent. Receipt of this packet does not verify that the command was received by the CIP, only that the command was sent to the transmitter.

```
XX/YYYY/00:00:00(CR)(LF)
```

Where:

XX	=	Address in hex
/	=	ASCII 2Fh
YYYY	=	command in hex
00:00:00	=	time the command was sent (GMT)
(CR)	=	carriage return (ASCII 13h)
(LF)	=	line feed (ASCII 10h)

4.4 ERROR MESSAGES

Error messages will be returned if the command is not formatted properly. The error messages are formatted as follows:

`S -ERROR(SP)00:00:00(CR)(LF)`	general error
`C -ERROR(SP)00:00:00(CR)(LF)`	address greater than 1Fh
`1 -ERROR(SP)00:00:00(CR)(LF)`	repetitions not equal

4.4.1 EXAMPLES

4.4.1.1 Properly Formatted Command from Science GSE

`12/0013/12:20:45(CR)(LF)`	Address 12h, Command 13h
`12/AB03/12:20:46(CR)(LF)`	Address 12h, Command AB03h

4.4.1.2 Repetitions Not Equal

```
S-ERROR 12:20:50(CR)(LF)
```

4.5 USER SINGLE LINE INTERFACE

The following outlines the format for an optional single line interface which passes balloon location and command echo information to the user. The information is sent on the same serial line used by the user command interface and does not interfere with this capability. The normal user command verification packet is still provided to the user, in addition to the command echo data.

4.5.1 CIP LOCATION INTERFACE

If the single-line interface is enabled, this information is sent to the user at 5- or 10-second intervals. If the selected GPS is updating, a packet will be sent every time a GPS packet is received (roughly every 5 seconds). If the selected GPS is not updating, a packet will be sent every 10 seconds with the last data received from the CIP.

The packet format is defined as follows:

```
HH:MM:SSLLLLLmmm.mLLLLLmmm.maaaaaaaapppppp.ppprrrrrrsssshhhhtt
tttt.t(CR)(LF)
```

Where:

HH:MM:SS	=	Time (GMT)	(00:00:00)
LLLLLmmmm.m	=	Latitude (degrees minutes.decimal_ seconds)	(%5d%5.1f)
LLLLLmmmm.m	=	Longitude (degrees minutes.decimal_seconds)	(%5d%5.1f)
aaaaaaa	=	GPS Altitude (ft)	(%8d)
ppppp.p	=	Pressure Altitude (millibars)	(%10.3f)
rrrrrr	=	GPS Ascent Rate (ft/min)	(%6d)
ssss	=	GPS Speed (knots)	(%4d)
hhhh	=	GPS Heading (degrees)	(%4d)
tttttt.t	=	Air Temperature ©	(%8.1f)
(CR)	=	carriage return	(ASCII 13h)
(LF)	=	line feed	(ASCII 10h)

4.5.1.1 Example of CIP Location Interface

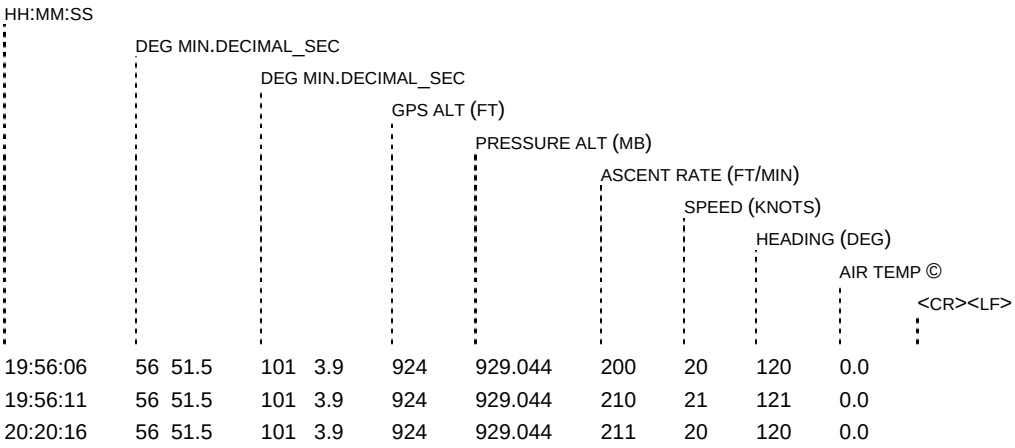

Figure 1 CIP Location Interface Example

4.5.2 CIP COMMAND ECHO

If the single line interface is enabled, every command echo received from the CIP will be sent to the user in the format described below. The command echo indicates the last command received by the CIP.

Data word commands are sent in two stages with the lower byte being sent before the upper byte. This will cause two command echoes to be returned for every data word sent.

```
ECHO/XX/YYYY/00:00:00*(CR)(LF)
```

Where:

ECHO	=	ASCII text to denote echo of command received by CIP

XX	=	address in hex
/	=	ASCII 2F$_h$
YYYY	=	command in hex
00:00:00	=	time command echo was received by GSE (GMT)
Asterisk	=	ASCII 2A$_h$
(CR)	=	carriage return (ASCII 13$_h$)
(LF)	=	line feed (ASCII 10$_h$)

Table 2 CIP Command Echo Examples

EXAMPLE	COMMAND
Address 12_H, Command 13_H	ECHO/12/0013/13:54:34*(CR)(LF)
Address 12_H, Command $AB03_H$	ECHO/12/0103/13:54:35*(CR)(LF) lower byte of data word + 100$_h$ ECHO/12/02AB/13:54:36*(CR)(LF) upper byte of data word + 200$_h$

5 NSBF GROUND SAFETY PLAN

5.1 SCOPE

This chapter is the Balloon Ground Safety Plan (BGSP) for operations performed by the National Scientific Balloon Facility (NSBF). The BGSP is derived from the NASA Goddard Space Flight Center (GSFC) Wallops Flight Facility (WFF) Range Safety Manual, identified as RSM 2002.

The NSBF BGSP applies to all balloon operations performed by the NSBF personnel at Palestine, TX, Fort Sumner, NM, or any remote sites.

The ground safety goal of the NSBF is to minimize risks to personnel and property in conducting operations and to prevent mishaps that might result in embarrassment to NSBF, NASA, and the United States Government.

It is the policy of the GSFC/WFF and NSBF that all systems be designed such that a minimum of two independent unlikely failures must occur to expose personnel to a hazard.

5.2 SAFETY RESPONSIBILITIES

The NSBF Operations Department Head (Campaign Manager at remote sites) is responsible to ensure compliance with the provisions of the BGSP for NSBF operations and for science user operations.

The NSBF Reliability, Safety, and Quality Assurance (RSQA) Department is responsible for institutional support for the NSBF and providing any special safety equipment to support the requirements of the BGSP.

The NSBF Radiological Safety Officer (RSO) is responsible for the receiving and provisions of appropriate storage for all radioactive sources brought to NSBF, Fort Sumner, or remote sites. He insures that procedures, handling, and storage are in compliance with NSBF policy and criteria and the Nuclear Regulatory Commission (NRC).

The Experimenter is responsible in supplying to NSBF documentation identifying hazards and control methods. The typical payload hazards can be identified in the Balloon Flight Support Application and the Ground Safety Data Entry Form. Other hazards shall be identified by filling out special payload safety forms. The user is also responsible for obtaining licenses from other agencies (e.g. a license for radioactive sources and removal of the source). Hazards will be identified in the user request for support and reviewed and approved by NSBF safety personnel.

No less than six months prior to flight, the NSBF is responsible to provide notice to the NASA Balloon Program Office of any intent to fly radiological sources. The NASA Balloon Program Office will submit requests for nuclear launch safety approval (NLSA). NLSA approval is prerequisite to use of any radiological source in flight. NSBF will provide information as to the number of sources, to include type, total activity, and packaging for each source intended to be flown on any balloon mission.

The Crew Chief is responsible to direct the movement and operation of all heavy equipment used in balloon launch operations in such a way as to ensure safety and minimize the number of personnel exposed to hazards associated with this equipment. The Crew Chief shall verify that all launch equipment is configured in accordance with the approved mechanical certification provided by the NSBF Engineering Department.

5.3 HAZARDOUS SYSTEMS CONTROL

The BGSP addresses the following hazardous systems and operations, and identifies the subsection where these hazards and their controls are addressed.

5.3.1 IONIZING RADIATION

All operations conform to the standard of the NRC, 10 CFR, and applicable regulations for the state or country in which operations occur.

The Experimenter provides the NSBF RSO with applicable Material Safety Data Sheets (MSDS) for each source being used.

The Experimenter will provide to the NSBF RSO the following:

- Sources to be used
- Total Activity
- Packaging
- Custodian

Prior to start of all operations, the MSDS will be read and reviewed by all involved personnel.

Procedures for the use, handling, and storage of the radioactive materials will comply with the specific procedures and policies identified in the NSBF Health and Safety Plan. A copy of these procedures must be posted in the work area.

Only persons officially approved by the NSBF RSO may handle radioactive sources.

No source shall be transported outside the designated storage/use area except by authorization of the NSBF RSO.

Where sources are sealed, eating and drinking and storage of personal items is permitted.

In the event of a mishap, such as fire, source rupture, or damage, immediate notification to the responsible safety person for this operation is required. This safety person will be identified prior to start of any operation and method of communication (phone, walkie-talkie, etc.) shall also be identified.

5.3.2 LASERS

The following information will be provided by the Experimenters. The experimenter shall seek direction from NSBF if he/she is not familiar with how to calculate nominal ocular hazard distance (NOHD) or optical density.

- Laser System
- Laser Class
- Wavelength
- NOHD
- Optical Density

For ground operations (e.g. for calibration or alignment) of Class III or IV lasers, the following personnel restrictions will be in place:

- Personnel within the NOHD shall wear protective goggles with an optical density as submitted by the experimenter.
- Items will be removed from the beam path and personal items (such as watches or other jewelry) will be removed that may cause specular reflections.
- The laser will be operated below eye level.
- There will be a target termination point for the beam.
- All personnel not directly involved in laser maintenance or calibration must evacuate the area during laser operations. A safety observer shall determine the beam path is clear at the beginning of the operation, and maintain the beam path clear for the duration of the laser operation.
- The area will be roped off or traffic cones will be placed around the beam path.
- Laser operation warning signs will be posted around the beam path area.

5.3.3 CHEMICALS

A general description of hazardous chemicals will be provided.

More complete safety information is given in the MSDS.

- Personnel shall become familiar with the hazards posed by hazardous chemicals by reading the MSDS. One set of material safety data sheets will be posted in the work area.
- The Experimenter/Scientist submits to NSBF RSQA, for approval, procedures for the safe storage, handling, transfer, spillage and use of chemicals.
- Hazard areas will be determined and properly roped off or designated using traffic cones.
- Appropriate personal protective equipment (PPE) such as clothing, face shields or safety goggles, will be worn when handling hazardous chemicals.
- For spillage, trained personnel will respond to clean up per “Chemical Spill Procedure” in the NSBF Safety and Health Plan. These procedures will be reviewed prior to the start of a normal operation and be posted in the work area.
- When required, eye wash stations will be available.
- All tanks and transfer lines will conform to applicable ASME and DOT regulations.

- The Special Safety Plan Form will be filled out when controls fall outside normal operations.

5.3.3.1 Typical Chemical Hazards and Emergency Responses

The guidance given in Table 3 is meant to be general in nature, and will not substitute for a better familiarity of the hazardous chemical obtained by reviewing the MSDS. Personnel who may come in contact with hazardous chemicals shall review the MSDS; especially review information in the MSDS addressing first aid and fire response.

NOTE: *See the MSDS for specific information.*

Table 3 Hazard Responses

CHEMICAL HAZARD	DESCRIPTION	RESPONSE
Caustic/acidic materials	Caustic/acidic materials can cause skin bums if they contact exposed skin and severe eye damage they get in the eye.	In the event of exposure to caustic or acidic substances, remove contaminated clothing and flush affected body part(s) with large amounts of water. Get medical attention as soon as possible.
Cryogenic material	Cryogens shall be handled in a manner that will prevent frostbite or injury to personnel. For cryogenic liquids, personnel shall wear a face shield, an apron, gloves, and closed-toed shoes. Pant legs are to be worn outside footwear. Tongs shall be used when handling dry ice.	For eye contact, immediately flush eye(s) for at least 15 minutes. For skin, contact warm frostbite area with warm water. Do not use dry heat. Remove any contaminated clothing. Get medical attention.
Flammable liquids and gases	The relative degree of flammability of a substance is determined from its flashpoint temperature; that is, the lower the flashpoint temperature, the. more flammable a substance should be considered. When using flammable liquids or gases, pre-test leak checks will be performed and chemical leak test procedures will be generated prior to starting any operation. If a leak occurs, operations will be suspended until the cause has been addressed and resolved.	Generally, for all flammable substances, dry chemical (i.e. Class ABC) fire extinguishers are acceptable for fighting fires. The fire extinguisher shall be available in the work area in the event of a fire.

CHEMICAL HAZARD	DESCRIPTION	RESPONSE
Toxic chemicals	The hazard of a toxic chemical leak is addressed by periodic system leak checking. If the hazard of exposure to the toxic chemical is considered severe by NSBF, additional measures may to be taken, such as continuous monitoring of the toxic chemical, and/or secondary containment of the toxic chemical.	In the event of toxic chemical inhalation, remove the victim from the contaminated environment, and allow victim to breathe fresh air. Put the victim on oxygen (if available) if the symptoms indicate a high level of exposure. Keep the victim warm, comfortable, and quiet. Seek immediate medical attention. For skin (or eye) exposure, remove all contaminated clothing, and flush affected area for at least 15 minutes. Seek immediate medical attention.

5.3.4 PRESSURE SYSTEMS

If the experimenter is supplying his/her own pressure system, the following information for the pressure system shall be supplied:

- Gas Bottle Pressure
- Regulator Pressure
- Tank Design Standard
- Safety Factor (Other Components: lines, fittings, regulator, valves, etc.)

Fill out the Special Payload Safety Plan Form for pressure systems that do not meet standard DOT or ASME pressure vessel requirements, and exceeds 19,130 Joules (14,240 ft-lbs), or have operating pressures greater than 100 psig for gases and 1000 psig for liquids. Tanks in these systems shall be designed to a standard agreed upon by NSBF, such as AIAA S-080 or AIAA S-081.

Pressure system assembly and operating procedures shall be submitted to NSBF RSQA for review and approval. NSBF has a certification and approval process for gondola/payloads having pressure systems.

5.3.5 PYROTECHNICS

All NSBF pyrotechnics are rated Class 1.4S explosives and are self-contained. NSBF personnel storing, handling, or installing pyrotechnics have had approved training. All electro-explosive devices (EEDs) must be 1 Amp, 1 Watt No Fire.

The Experimenter will provide the following to NSBF:

- Device
- Quantity
- Function
- Resistance
- Pin-to-Case Resistance
- No-Fire Power and Current
- All Fire Current

The Experimenter will identify hazards, and develop installation procedures submitted to NSBF RSQA for approval.

5.3.6 HEAVY EQUIPMENT OPERATION

All NSBF lifting devices will conform to NASA-STD-8719.9.

When using pins to suspend payload, two safety related cables will be attached between launch head and truck plate, which restrains the truck plate.

Regular inspections are performed according to procedures in NSBF Operations Policy 08-92-31, "Inspection of Tiny Tim". A copy of these procedures will be onboard Tiny Tim.

The NSBF Support Engineering Department is responsible for providing mechanical certification of the spool, spool restraining vehicle, flight train, and launch vehicle for each launch configuration used at NSBF and remote sites. Guidelines for certification will be to ensure mechanical integrity of the entire system at the maximum planned gross inflation should the system be exposed to a 20 knot wind directly behind the balloon bubble at the completion of inflation.

5.3.7 HOT FLIGHT TERMINATE SYSTEM

"Hot" is defined as mating of pyrotechnic squib, motor, or actuator to the connector going to the initiator device (continuity plug) prior to start of inflation of balloon. For this specific operation, only trained personnel will be allowed in this hazard area.

- Electric wiring and power source will be completely independent and isolated from all other systems.
- All electro-explosive devices (EED) will be connected with approved shorting devices until assembled on launch pad.
- NSBF staff members who assemble and install EEDs will have had training and be certified to perform EED installation.

5.3.8 NON-IONIZING RADIATION

Compatibility tests with NSBF flight systems will have been performed for all radio frequency (RF) sources brought to NSBF or remote sites. The experimenter will provide all requested information pertaining to his/her RF system, so that NSBF may coordinate frequency utilizations and authorizations.

To determine the RF hazard distance between an irradiating emitter and a pyrotechnic device, the experimenter will fill out the RF Pyrotechnic Hazard Distance E Worksheet.

To determine the safe separation distance between an irradiating emitter and personnel, the experimenter will fill out the RF Personnel Hazard Distance Worksheet. Particular attention will be paid to high power emissions of:

- TDRSS Omni Antennas and High Gain Antennas
- Science provided emitters greater than 1 watt for L/S Band
- Any L/S Band emitters greater than 1 watt
- Any UHF/VHF emitters greater than 1 watt

More specific guidance (if required) for RF hazards to personnel may be found in IEEE C95.1-1999, which is listed in the references in Section 5.5 on page 23.

5.3.9 ELECTROSTATIC DISCHARGE

Precautions are taken to reduce electrostatic discharge during balloon inflation.

- For balloon launch operations, static dissipating fluid will be applied to balloon ground cloth
- A drag chain will be installed on launch vehicle to eliminate static charge

Prior to removal, alteration of configuration, or opening of any electronic initiator system, ensure that pyrotechnic devices are electrically separated from such initiators and placed in a safe configuration with shorting plugs.

5.3.10 ELECTRICAL STORM

Balloon inflation will not begin if an electrical storm is detected within 10 NM of launch site, which is in accordance with NSBF Operations Policy 8-74-5, “Thunderstorms and Launch Restrictions”.

If no equipment is available to detect electrical storm activity, inflation will be halted, and hazardous areas cleared upon hearing thunder or observing weather conditions that have an immediate potential of producing an electrical storm.

5.4 OPERATIONAL CONTROLS

5.4.1 PRE-INFLATION PHASE

This phase extends from the time that the payload is physically attached to the balloon launch vehicle prior to leaving the assembly area, and extends to the point that inflation of the balloon commences.

Hard hats are required for personnel from the pre-inflation operations phase through the launch operations phase.

5.4.1.1 Tiny Tim Operation

- Vehicle engine will be off when attaching the “Tim” fitting.
- No personnel will be permitted to walk out on jaws of Tiny Tim when its engines are running.
- The hydraulic safety column is a secondary support when the payload is suspended from the jaws of Tiny Tim.
- No personnel will be allowed under the suspended payload while the Tiny Tim vehicle is holding the payload.

5.4.2 INFLATION PHASE

This phase starts when lifting gas is applied to the balloon, after it is connected to the complete flight system. The phase is complete when all lifting gas has been transferred to the balloon and all pre-flight preparations are complete.

- Hydrogen gas will not be used for balloon inflation except under special procedures that have been specifically reviewed and approved by the NSBF

Operations Manager, NSBF RSQA, NSBF Site Manager and NASA Balloon Program Office.

- A Category A hazard condition results when the NSBF Flight Terminate System is made "hot" by insertion of the continuity plug and balloon inflation begins. This Category A hazard continues through balloon launch or until helium is released from the balloon envelope or until the continuity plug is removed from the NSBF Flight Terminate System.
- The Category A hazard area is defined as extending from the NSBF parachute cut-away device to the launch spool. This area extends 10 feet on either side of the package and balloon up to the launch spool with a 50 foot radius around the center of the launch spool.
- Personnel will not straddle or remain under any portion of the parachute or balloon at any time when this Category A hazard exists.
- Hearing protection is required for the Helium diffuser operators and all other personnel working within 75 meters of the balloon bubble during inflation.
- The only personnel allowed within this Category A hazard area are NSBF launch personnel trained to perform the following operations:
- Stripping of protective wrap from the balloon at a position behind the launch spool
- Stripping of protective wrap from the balloon from the balloon base fitting to the spool from a position on either side of the balloon
- Inspection and documentation of the balloon and associated flight hardware from either side of the parachute and balloon
- Installation of the balloon collar by the launch crew chief and support technicians
- Deploying the terminate box assembly as slack is taken out of the system during inflation

5.4.3 BALLOON LAUNCH PHASE

- The Category A hazard area for the balloon launch phase is defined as a rectangular area on the ground from the payload on the launch vehicle to the launch spool and extending one half of this distance to either side of line between the payload and launch spool. The area also consists of a semicircle in front of the launch vehicle with a radius equal to one-half the length of the total flight system.
- Category A hazard condition exists from the time that the balloon is released from the spool until the payload is released from the launch vehicle.
- All personnel and vehicles are excluded from this area except for NSBF launch crew personnel assigned to duties on the NSBF payload launch vehicle, and the spool operator, who will be located at the spool vehicle.
- The number of personnel riding on the launch vehicle during an operation will be minimized to reduce hazards during launch. A minimum crew will consist of the Crew Chief, Driver, one or two mechanical technicians to push the payload off at launch, and an electronics technician.
- An electronics technician will ride on the launch vehicle with an approved portable command system capable of terminating the flight upon command from the Crew Chief.
- The Crew Chief shall be solely responsible for signaling the spool operator to release the balloon from the spool. An approved communication mechanism

(handy talkie, launch vehicle light system, etc.) shall be employed by the Crew Chief to signal the spool operator to release the balloon.

- If communications between Crew Chief and Spool Operator are lost, operations will be suspended until the communication problem is resolved.
- The spool mechanism will be designed such that two actions are necessary to activate the spool and release the balloon (i.e. safety pin and lever release.)
- An electronic intercom system will be installed on the launch vehicle such that at a minimum, the Crew Chief, driver and electronics technician have voice communication. This system will be independent from other voice communication systems to eliminate the possibility of interference.
- For crane-head launches two safety cables will attach the truck plate to the crane head. The cable release mechanism to launch the balloon will be an NSBF Mechanical Engineer approved mechanical lever arm.
- For Tiny Tim launches, the jaw release mechanism requires two actions to arm the Crew Chief 's launch button. On Tiny Tim, a separate jaw release switch will be located in the driver's cab should the Crew Chiefs release button malfunction. This switch shall be protected from inadvertent actuation by a hinged cover until immediately prior to balloon releases.
- The Crew Chief shall be responsible for deciding whether to initiate spool release and balloon launch. If at any point during an operation, the Crew Chief observes conditions that could result in danger to personnel, the decision will be made to destroy the balloon in the spool or terminate the flight prior to payload release.
- Balloon collar release will be initiated by command of the Campaign Manager or his designee. The person issuing the command will be located in a safe area off to the side of the operation where the entire flight train is visible. Collar release will take place such that there is no danger of the collar, collar receiver or protective foam striking personnel riding on the launch vehicle.

5.4.4 RECOVERY

- Trucks used for recovery will comply with applicable DOT regulations.
- Scientific users will identify specific hazards and procedures associated with pick-up, disassembly, and transportation back to launch site.
- Recovery team will be briefed prior to launch.
- Whenever possible, a representative of the user will accompany the recovery team.
- A special recovery plan is prepared as needed (superconducting magnets, lasers, radioactive materials, etc.).
- When applicable, pressure vessels and cryogenic Dewars have the pressure relieved and rendered safe per approved procedures submitted on the recovery form.
- Lithium batteries will be disconnected and stored in approved shipping containers prior to transport back to launch site.
- When required, the recovery team personnel shall wear protective clothing and equipment.

5.5 REFERENCES AND OPERATIONAL PROCEDURES

Range Safety Manual for GSFC/WFF (RSM-2002)

NSS-STD 1740.12, *Safety Standard for Explosives, Propellants, and Pyrotechnics* (NASA-STD-8719.12)

GMI 1710.6, *Certification and Recertification of Lifting Devices and Equipment and Critical Lift Requirements*

IEEE C95.1-1999, *American National Standard Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 30KHz to 100GHz*

GHB 1860.2, *Radiation Safety Handbook*

GPG 1860.1, *Radiation Protection–Ionizing Radiation*

ANSI Z136.1-1993, *American National Standard for the Safe Use of Lasers*

GHB 1860.3, *Radiation Safety–Laser*

NPD 8710.5, *NASA Safety Policy for Pressure Vessels and Pressurized Systems*

NPG 1700.6, *Guide for In-service Inspection of Ground Based Pressure Vessels and Systems*

NSBF Safety and Health Plan

CFR,Title 10, Parts 19 and 20

NASA-STD-8719.9, *Safety Standard for Lifting Devices and Equipment*

NSBF Policy # 4-74-2, “Balloon Tracking and Recovery”

NSBF Operations Policy # 08-92-31, “Inspection of Tiny Tim”

NSBF Operations Policy # 04-86-28, “Procedures for Storage, Safe Handling, and Installation of Ordnance Devices”

NSBF Operations Policy #8-74-5, “Thunderstorm and Launch Restrictions”

NSBF OF-603-00-P Rev A, “Launch Equipment Configuration Certification Process”

6 PAYLOAD SAFETY PROCESS

6.1 GENERAL

This chapter outlines NSBF's process of certifying and documenting that a balloon payload is in compliance with applicable safety requirements during integration and launch. It addresses the tasks, responsibilities, submittals, safety reviews/meetings, and schedules associated with the process. The philosophy of the NSBF payload safety process is that the NSBF scientific user is responsible for insuring that the payload is in compliance with NSBF policy. NSBF is responsible for checking, monitoring, and documenting compliance.

From a safety standpoint, payloads flown by NASA's Balloon Program pose reduced risks in comparison to other NASA Expendable Launch Vehicles. Hazards associated with balloon payloads fall into a somewhat limited and generic set of safety considerations. Standard safety hazards in ballooning can be categorized as follows.

- Radioactive Sources
- Lasers
- Chemical Hazards
- Pressure Vessels
- High Voltage
- Contained Pyrotechnics

Safety compliance requirements for the above hazards are addressed in the *NSBF Balloon Program Ground Safety Plan* (Chapter 5 on page 14). Identified safety hazards that fall outside these areas are handled through separate safety plans and reviews. The following paragraphs describe the process. Table 1 is an abbreviated depiction of the NSBF Payload Safety Process.

6.2 INITIATE PROJECT AND DOCUMENT SAFETY ASSESSMENT

6.2.1 IDENTIFY HAZARDS FALLING WITHIN NSBF GROUND SAFETY PLAN

The NSBF Flight Application Form is sent out to prospective users in July of each year. The form includes a safety questionnaire covering hazards normally associated with balloon payloads. The NSBF Ground Safety Plan is attached to the Flight Application so the prospective user can identify safety issues and determine whether the payload is in compliance with NSBF Policy.

6.2.2 IDENTIFY HAZARDS FALLING OUTSIDE NSBF GROUND SAFETY PLAN

The Flight Application also contains questions about safety hazards not covered in the Ground Safety Plan. This is the means whereby special cases are identified and flagged. The Flight Application requests that the user forward all home institution safety documentation to NSBF. Most balloon payloads originate at NASA centers or universities. Users are usually required to undergo rigorous safety processes at their home institutions while building up their instrumentation. This documentation is used by NSBF as a further check of compliance with safety requirements.

6.2.3 USER VERIFICATION OF COMPLIANCE WITH NSBF GROUND SAFETY PLAN

The principle investigator is required to submit signed documentation indicating that the payload is in compliance with NSBF safety standards delineated in the Ground Safety Plan. This form is sent to NSBF prior to shipment of the payload to the launch site.

6.2.4 USER-PREPARED SPECIAL SAFETY PLANS

When the user identifies a safety issue falling outside those covered in the NSBF Ground Safety Plan (i.e. superconducting magnet, toxic gas, etc), a separate safety plan must be prepared by the user and submitted to NSBF for review. The NSBF Safety Officer is responsible for review of these plans for compliance with established industry safety standards.

6.3 CONDUCT SAFETY REVIEWS

6.3.1 REVIEW STANDARD AND SPECIAL PAYLOAD SAFETY ISSUES AND PLANS

Program Review Meetings are held monthly at NSBF to discuss support of upcoming campaigns and operations. Flight Applications and project files are reviewed in some detail. Safety related status, concerns, and issues are discussed. Action items on safety compliance are documented and tracked.

6.3.2 RESOLVE OPEN SAFETY CONCERNS, ACTION ITEMS, AND DISCREPANCIES

Response and close of safety related action items for each upcoming operation are discussed at the monthly Program Review Meetings. Closer of action items are the responsibility of the Operations Manager or the assigned Campaign Manager. Emphasis is placed on insuring that applicable safety documentation is at NSBF prior to shipping the instrumentation to the launch site.

6.4 FINALIZE AND APPROVE SAFETY ASSESSMENTS / PLANS

6.4.1 PREPARE BALLOON SYSTEM PRE-LAUNCH SAFETY PACKAGE (BSPSP)

Immediately following the scientist's arrival at the launch site, a Flight Requirements Meeting is held. The Flight Application Form is reviewed for compliance with standard and special safety issues prior to beginning of payload integration. The signed Payload Safety Compliance form, special safety plans for non-standard hazards, and user institution safety documentation is reviewed, discussed, and assembled into the Balloon System Pre-Launch Safety Package (BSPSP). Unresolved issues, if any are referred to the NSBF Safety Officer. The completed BSPSP package serves as a formal approval of the project from a safety standpoint.

6.5 PERIODIC COMPLIANCE CHECKS

6.5.1 VERIFY COMPLIANCE WITH SAFETY PROCEDURES / PLANS

The NSBF Operations Manager or Campaign Manager is responsible for periodic inspection of integration areas for compliance with routine and special safety procedures and plans. These inspections will typically take place on at least a bi-weekly basis.

6.6 PRE-LAUNCH REVIEW

6.6.1 REVIEW APPLICABLE SAFETY PLANS WITH FLIGHT LINE PERSONNEL

Flight Readiness Review meetings are held once the science payload is flight ready and no sooner than 72 hours prior to a scheduled launch. Standard flight line payload safety procedures and special safety plans, if any, are reviewed with appropriate personnel. Checklists are used to insure safety compliance. These meetings are rescheduled every 72 hours should a launch delay occur.

6.6.2 RECOVERY PLAN

A completed form indicating step by step instructions for safe payload handling during recovery operations is submitted by the principle investigator at the Flight Readiness Review meeting. This form is reviewed and approved by the Flight Director. Should extraordinary safety measures be necessary during recovery, a formal plan is written, reviewed, and discussed with recovery personnel.

6.7 DOCUMENTATION

Table 4 lists documentation generated during the Payload Safety Process, who is responsible for generating it, and required signatures on the accompanying documentation. At the conclusion of each flight, all payload safety documentation will be archived in the flight folder.

Table 4 Payload Safety Process Documentation

DOCUMENT(S)	RESPONSIBLE PARTY	REQUIRED SIGNATURES
Flight Application Form	Science P.I.	Science P.I.
Special Safety Plans	Science P.I.	Science P.I.
User Institution Safety Documentation	Science P.I.	User Institutional Safety Office Representative
Verification of Safety Compliance Form	Science P.I.	Science P.I./NSBF Ops Manager
Program Review Meeting Action Item and Closure	NSBF Operations Manager	NSBF Operations Manager
BSPSP	NSBF Campaign Manager	NSBF Campaign Manager
Pre-Flight Readiness Meeting Checklist	NSBF Flight Director	NSBF Flight Director

DOCUMENT(S)	RESPONSIBLE PARTY	REQUIRED SIGNATURES
NSBF Recovery Form	Science P.I.	Science P.I./NSBF Operations Manager

Table 5 NSBF Payload Safety Process

TASK #	SAFETY TASK DESCRIPTION	RESPONSIBILITY	PRODUCT OR MEETING	SCHEDULE
Initiate Project and Document Safety Assessment				
1.1	Identify safety hazards falling within NSBF Ground Safety Plan	NSBF Operations Manager	Flight Application document delineating standard safety issues	3-9 months prior to payload shipment to launch site
1.2	Identify safety hazards falling outside of standard NSBF Ground Safety Plan	NSBF Operations Manager	Flight Application document delineating special safety considerations	3-9 months prior to payload shipment to launch site
1.3	User prepared special safety plan for hazards not covered in NSBF Ground Safety Plan	Science Principle Investigator	Written Safety Plan for special hazards	1 month prior to shipment to launch site
Conduct Safety Reviews				
2.1	Review Standard and Special Payload Safety Issues and Plans	NSBF Site Manager/ Operations Manager	Program Review Meetings. Safety-related concerns/issues and action items documented in meeting minutes	At least monthly beginning 3 months prior to shipment to launch site
2.2	Resolve open safety concerns, action items and discrepancies	NSBF Operations Manager	Program review Meetings-Response and closure of concerns and action items	Assigned
Finalize and Approve Safety Assessments/Plans				
3.1	Prepare final Balloon System Pre-Launch Safety Package (BSPSP)	NSBF Operations Manager/ Campaign Manager	Flight Requirements Meeting. Assemble Payload Safety Compliance Form, safety plans for non-standard hazards, and user institution safety documentation	Immediately following arrival at launch site
Periodic Compliance Checks				
4.1	Verify that procedures/plans are being followed	NSBF Operations Manager/ Campaign Manager	Verbal warning of science users or written discrepancy reports (depending on severity)	Periodic from payload arrival at launch site through launch
Pre-Launch Review				
5.1	Review applicable routine and special safety issues and plans with flight line personnel	NSBF Flight Director	Flight Readiness Meeting. Completed pre-flight checklists	<72 hrs prior to launch
5.2	Recovery Plan	NSBF Flight Director	Flight Readiness Meeting. Completed Recovery Form or plan	<72 hrs prior to launch